of Zurich University. Scientific men proposed by the scientific council are in the first instance admitted to working places, and also other investigators of any nationality. A branch station is connected with the institute and the observatory well equipped and in the best imaginable situation at a height of 2,500 meters on Muottas-Muraigl near Samaden (Engadine), easily accessible by a funicular railway. The publications issued having their origin in researches supported by the funds of the institute will bear in their title a notice referring thereto. For the equipment of the institute so far 55,000 Swiss francs are available (wherein the value of the instruments of the observatory valuated at 80,000 Swiss francs is not comprised), and the budgets of the first year amount to 57,000 Swiss francs.

On January 3 to 5, 1924, a belated modest inauguration took place, in which the Federal, cantonal, and communal authorities, representatives of the universities of Zurich, Basel, Bern, and of the scientific council composed of professors of the Swiss universities and of physicians, took an active part.

A METEOROLOGIST AT SEA

Dr. C. F. Brooks, associate professor of meteorology and climatology at Clark University, Worcester, Mass., recently made a voyage to the West Indies for the threefold purpose of (1) observing winter weather and its effects on the people, (2) obtaining a series of comparative surface water temperature and weather observations, and (3) determining the best method of making sea surface temperature observations. A report of the investigation will appear in a subsequent issue of the MONTHLY WEATHER REVIEW.

During the last stage of the return voyage, when the vessel on which Doctor Brooks was a passenger, the *Empress of Britain*, was proceeding from Bermuda to New York, a storm of considerable proportions was encountered. Doctor Brooks has prepared the following account of this storm, which is of special interest as coming from a meteorologist rather than a seaman. —Ed.

SOME NOTES ON THE WEATHER, MARCH 21-23, 1924, BERMUDA TO NEW YORK

By C. F. BROOKS

The weather on the 21st at Bermuda was very rainy; heavy showers of rain occurred, especially at about 10 a. m. and 1 to 2 p. m. The first shower marked the arrival of much warmer, moister air, and the second one came just before a very great increase in wind velocity, accompanying a shift in direction from SE. to SW. For about an hour around sunset the sky was clear. Then, however, low clouds formed as the wind shifted to WSW. A line of clouds marked with moderate to brisk showers passed over at about 8:40 p. m. at the time the wind shifted from WSW to W. Thereafter, the sky was partly cloudy with alto-cumulus and strato-cumulus, the wind increasing all the time. Shortly before midnight the sky was practically clear. During the night, however, there was more cloudiness and some showers. Shortly before 6 a. m., the 22d, there were ragged clouds at two or three levels, with patches of greenish blue sky here and there, and with a number of showers visible in different directions. The clouds thickened and at 8 presented a rather solid looking wall across the northwestern sky. At 8:40 the rain front of the main wind-shift line reached us, and three-quarters of an hour later the wind shifted suddenly from a fresh westerly gale to a fresh north-northeasterly one. The pressure began to rise rapidly from its low point of about 29.15 inches, maintained since 2 a. m. In the latter part of the morning the atmospheric pressure in my stateroom was varying up and down as much as 0.14 of an inch with the movement of the ship. This appears to have been a combination of the change in altitude with the passing waves, and also the relative compression in the ventilator as the ship rolled from side to side.

The sky remained continuously cloudy with strato-cumulus from which occasional showers fell till about noon when the sun began to shine now and then. During the early afternoon, though the strato-cumulus clouds looked very heavy, it was not possible to tell whether there were any light showers or not. There was an unceasing rain of salt spray over the ship all the time, with occasional falls of considerable masses of water. Later, as the temperature of the water rose, as we approached the center of the Gulf Stream, the sea became rougher and showers general. At the time of the highest water temperature (71) shortly after 6 p. m. the sea was roughest, the propellers of our ship coming out with practically every wave, and the cloud cover was denser and apparently more rainy. Immediately we passed from water at 71 into water of 54 at 7:30 p. m., however, the sea quieted considerably, and the sky partly cleared. The gale continued, however, for some hours more. Before sunrise the next morning the weather was clear and quiet, though there was still a moderate ground swell to give us a suggestion of the storm we had just run out of.

THE MOVEMENT OF THE CYCLONE OF MARCH 8, 1924, ACROSS TEXAS

551.515 (764)

ALFRED J. HENRY, Meteorologist

[Weather Bureau, Washington, April 17, 1924]

The type of pressure distribution shown in Figure 1 is one of particular interest to forecasters of the United States Weather Bureau; interesting because there is often a distinct hiatus in the path of cyclones that pass from the high plateau of New Mexico to the plains of Texas, and consequently a certain degree of uncertainty as to their future course and development.

It is a rather remarkable fact that extratropical cyclones in winter occasionally advance from the Pacific about north latitude 45° to 50° southeastward directly to Texas or the lower Mississippi Valley without apparently losing any kinetic energy. The rapidity of movement leads to the inference that friction with the exceedingly rugged topography of the path followed is absent and further that the bottom portion of the whirl is cut off as it crosses the mountains. In some way not clearly understood, the middle and top parts of the whirl conserve their original energy until they arrive in the region where warm moist currents are found in the levels next to the surface. So soon as that region is reached connection with the surface is again completed and the storm pursues its normal course with unabated energy.

In this particular case (see fig. 1[1]) the level of the barometer in the center of the cyclone is rather low and

[1] For the path of the cyclone here illustrated see track No. IV of chart II, this REVIEW.

the cyclone is flanked on the north and west by much higher pressure and low temperature. After making allowance for errors in sea-level barometric reduction for elevated plateau stations there remains a rather steep barometric gradient for northerly winds in the region occupied by the cyclone center; the low surface temperature and the absence of moist air in the imme-

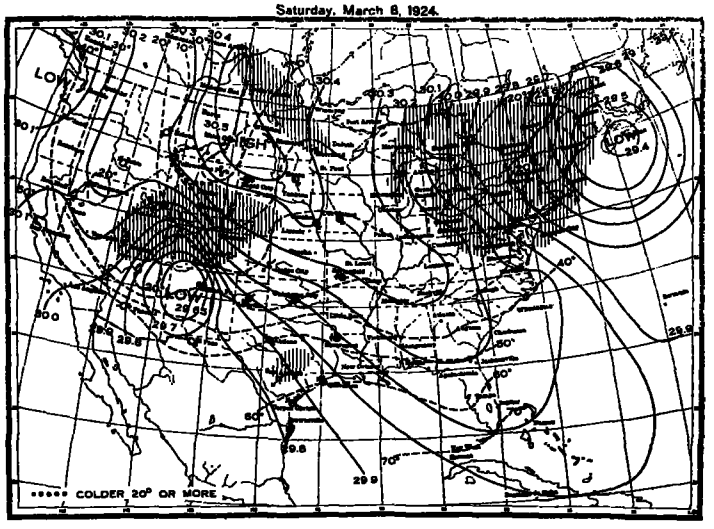

FIG. 1.—Daily weather map, 8 a. m., 75th meridian time; shaded areas indicate regions of rainfall in last 24 hours. Symbols showing state of sky at time of observation are given only for stations within the region covered by the cyclonic storm (the LOW)

diate front of the cyclone apparently make for an early dissolution of the disturbance. A second, and the more likely, alternative is that the cyclone center will be displaced far to the southeast by the inflow of cold northerly winds. Any displacement in that direction will bring

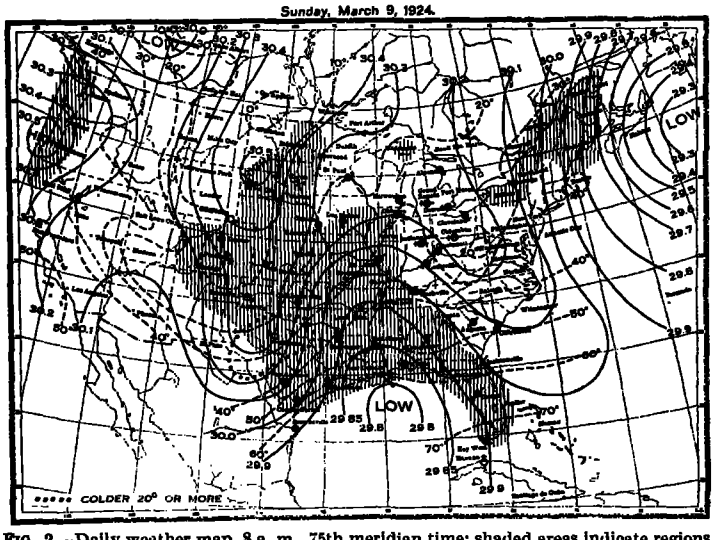

FIG. 2.—Daily weather map, 8 a. m., 75th meridian time; shaded areas indicate regions of precipitation in the last 24 hours; the state of the sky at time of observation is shown for stations around the storm center by the shading of the small circles; half-shaded indicates a sky half-covered, etc. R indicates rain, S snow falling at time of observation.

it into regions where the natural atmospheric conditions are favorable to the development of cyclones.

Free-air observations from instruments carried by kites are available from several stations within the probable path of the cyclone in question. The geographic coordinates of the stations are shown in the exhibit below:

Station	N. lat.	W. long.	Altitude
	° ′	° ′	*Feet*
Groesbeck, Tex	31 30	96 28	461 (141 m.)
Broken Arrow, Okla	36 2	95 49	765 (233 m.).
Due West, S. C	34 21	82 22	711 (217 m.).
Royal Center, Ind	40 53	86 29	736 (224 m.).

I have assembled in Table 1 such free-air observations as were obtained on March 8–9, when the cyclone in question was approaching and passing the stations named. Figure 1 shows that while the cyclone center was in New Mexico a great cloud sheet had covered Texas and other regions to the eastward of the center. Rain had set in at Dallas, Taylor, and San Antonio, Tex., and snow was falling in eastern Colorado, southeastern Wyoming, and locally in Nebraska, Kansas, and Missouri.

The free-air observations.—From Table 1 it will be noted that surface winds in Oklahoma and Texas were from an easterly quarter and shallow and that at both Groesbeck and Broken Arrow they turned through S. to SSW. or SW. The top of the Groesbeck flight was reached at 2,255 m. and the wind at that level was from the SW. The flight at Broken Arrow reached an altitude of 3,590 m. where a SSW. wind prevailed. On March 9 after the cyclone had passed to the eastward N. and NW. winds prevailed up to the highest points reached by the kites at both stations.

TABLE 1.—*Free-air observations*

[Altitude in meters above m. s. l.; temperature in deg. C.]

GROESBECK, TEX.

	Sur.	500	750	1,000	1,250	1,500	2,000	2,500	3,000	3,500
Mar. 8, T	12.3	12.5	11.8	10.3	8.8	7.4	4.8	.....	.....	.....
Mar. 9, T	1.3	−1.9	−4.0	−2.6	−0.3	0.9	2.8	−0.7	.....	.....
Mar. 8[1], W	E.	SE.	SSE.	S.	S.	SSW.	SW.	.....	.....	.....
Mar. 9, W	NNW.	NNW.	NNW.	NNW.	NNW.	NNW.	NNW.	W.	.....	.....

BROKEN ARROW, OKLA.

Mar. 8,[2] T	0.0	−0.5	0.6	2.6	3.4	2.4	0.2	−3.2	−6.5	−9.9
Mar. 9, T	−4.6	−6.5	−8.3	−7.7	−8.4	−9.8	−9.7	−9.4	−11.0	.....
Mar. 8, W	NE.	E	ESE.	SSE	S	SSW.	SW.	SSW.	SSW.	S.
Mar. 9, W	N.	N.	N.	N.	N.	NNW.	NW.	NW.	NW.	.....

DUE WEST, S. C.

Mar. 9,[3] T	5.6	6.2	6.4	4.7	3.0	1.4	−2.0	−5.3	.....	.....
Mar. 10, T	4.5	1.6	−0.9	−3.1	−5.5	−7.1	−10.7	.....	.....	.....
Mar. 9, W	ENE.	E	SE.	SE.	SSE.	SSE.	SSE.	S.	.....	.....
Mar. 10, W	W.	W.	W.	W.	W.	WNW.	W.	.....	.....	.....

ROYAL CENTER, IND.

Mar. 9,[4] T	−1.0	−4.0	−6.8	−8.3	−9.2	−7.2	.....	.....	.....	.....
Mar. 9, W	E.	E.	E.	E.	ESE.	ESE.	.....	.....	.....	.....

[1] St. cu. from SW. throughout flight; base at 1,700 m. at 10 a. m.; rain at end of flight.
[2] Ci. and A. cu. west at beginning, changing to 10 A. cu. SW. at end of flight.
[3] 10 A. st. WSW. at beginning, changing to 4 A. st. WSW., 4 A. cu. SW., and 2 St. S. at end.
[4] Snow during flight.

The free-air temperatures on the 8th, when the cyclone center was about 800 miles distant, are shown for the several levels reached by the kites. At Groesbeck on the 8th there was a small inversion of temperature at 500 m.; above that level, although the winds were southerly, the temperature steadily decreased. The lapse rate was clearly less than the dry adiabatic. On the 9th the winds were NNW. except that at the top of the flight

a W. wind prevailed. This NNW. wind was considerably stratified as regards temperature, there being a cold stratum at 750 m. (−4.0° C.) above which temperature rose to a maximum of 2.8° C. at 2,000 m.; then followed a rather sharp fall as the wind backed to W.

At Broken Arrow on the 8th the winds up to 3,000 m. conform both as to direction and clockwise turning with those of Groesbeck. On the succeeding day they were more northerly than at Groesbeck.

The temperature of the free air at Broken Arrow on the 8th shows a weak minimum at the 500 m. level, and a distinct rise from that level to a maximum at 1,250 m.; thence to the top of the flight the temperature fell 13.3° C. in 2,250 m.—a not unusual fall in temperature—in southerly winds. On the following day with northerly winds the air column was uniformly colder, as would be expected, although the difference at the 3,000-m. level was but 4.5° C.

On March 9 (see fig. 2) the center of the cyclone was apparently off the mouth of the Mississippi, although its position is dependent upon the single barometer reading of New Orleans, La. It is evident that there was not a movement of translation from New Mexico on the 8th to the Gulf of Mexico on the 9th, but rather that a new cyclone developed in the southern end of the barometric trough that is present in Figure 1, paralleling the Rio Grande Valley. (See the isobar of 29.80 inches.)

Consider now the observations made at Due West, S. C., which on the 9th was in relatively the same position with respect to the cyclone center as Groesbeck and Broken Arrow were on the previous day. The free-air winds at due West were from an easterly quarter with the same clockwise turning through S. to SW. as obtained at the two stations first discussed. The high clouds at this station, as also in Texas and Oklahoma, were moving from a southerly quarter. (See footnotes of Table 1.)

A small inversion of temperature is apparent at Due West between surface and 750 m. and a steady decrease from that level to the top of the flight. The decrease between 2,000 and 2,500 m. as the winds shift from SSE. to S. is rather pronounced.

The precipitation at Royal Center, Ind., owing to the high latitude of the station, was in the form of snow rather than rain. Easterly winds with a snowstorm prevailed at that station and the flight was not a high one.

The clockwise shift of the wind at Royal Center suggests that at that station, although at a great distance from the cyclone center the winds at higher elevations than those recorded must have been from a southerly quarter.

The barometric situation on the 8th and 9th compared.—The outstanding feature of the map of the 8th (fig. 1) is the ridge of high pressure that extends from Canada southeastward to Florida and the accompanying thrust of cold northwest winds. This ridge lying athwart the path of the New Mexico cyclone threatens the existence of the latter. Apparently, however, the danger to the New Mexico cyclone was not in the eastern ridge of high pressure but in the more direct and vigorous thrust of cold northerly air in its rear which reached the Gulf of Mexico by the morning of the 9th. The situation is now completely changed and the conditions for very generous and widespread precipitation in the great central valleys and Atlantic Coast States are almost ideal, viz, a trough of low pressure between two ridges of high pressure. From its position on the 9th the cyclone advanced northeastward, reaching the Delaware Capes on the 11th as a circular depression with central pressure of 29.00 inches. Heavy snow for the season fell in the Middle Atlantic and New England States.

The data here presented, and other evidence of a similar character, seem to indicate that for the continent of North America, at least, the southerly winds on the front of the cyclone, generally much stratified as to temperature, and the northerly winds in its rear, less stratified than those first mentioned, are the two most impressive phenomena in connection with cyclonic activity. These two major currents are not to be considered as opposing currents, but rather as currents one of which regularly supplants the other in practically the same levels.

The time required for the completion of the cycle warm–cold is short, a day or so, and it evidently bears a direct relation to the cycle, cyclone–anticyclone, which of course varies with the season and the latitude.

Each system of warm southerly winds must, of course, have two border zones, one on the left and one on the right as one faces toward the south. The movement of the air in the vertical on the right margin is pretty clearly established as an underrunning of the warm by the cold northerly current. The movement in the vertical on the left margin is not so clearly indicated; in the opinion of the writer the locus of cyclonic activity will be found nearer the left margin than the right.

In some respects these two wind systems, as conceived by the writer, are similar to the warm and cold currents postulated by the Norwegian school of meteorologists, although the details differ in several particulars. The generous cooperation of the Aerological Division of the bureau in the preparation of this paper is gratefully acknowledged.

551.578.4(775)

THE SLEET, GLAZE, SNOW, AND WINDSTORM IN WISCONSIN, FEBRUARY 3–6, 1924

By W. P. STEWART, Meteorologist

(Weather Bureau, Milwaukee, Wis., March 29, 1924)

This storm occurred in connection with a marked area of low pressure which came up the Mississippi Valley on February 3 and 4 and passed slowly northeastward over Illinois, Indiana, and Michigan on the 5th and 6th. Southern and eastern Wisconsin were within the area of precipitation from February 3 until the morning of the 7th, and during that period heavy snows occurred over the greater part of this section. It was heaviest near Lake Michigan. At Milwaukee the heaviest 24-hour snowfall of record, 20.3 inches, occurred on the 4th–5th, and the total fall in the storm was 22 inches. At Manitowoc there was 25.5 inches, at Sheboygan 18 inches, at Port Washington 16 inches, at Racine 17 inches, at Sturgeon Bay 15 inches, and over a large part of central and southern Wisconsin the fall was from 10 to 12 inches.

There was a high east and northeast wind on the 3d, 4th, and 5th, and the snow drifted badly. Railway and interurban traffic was delayed 1 to 3 days. The most serious interruption to train service occurred in the territory north of Milwaukee, on the routes along the lake shore and in the vicinity of Fond du Lac and Oshkosh, where the schedules were interrupted from the night of the 4th until the afternoon of the 6th, and service was not fully restored until the 8th. Between Milwaukee and Chicago the service was interrupted from 9 p. m. the 4th until the afternoon of the 5th.

There were many miles of snowdrifts 8 to 12 feet high and highway traffic was blocked generally throughout the